979,616

PATENT SPECIFICATION

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DRAWINGS ATTACHED.

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COMPLETE SPECIFICATION.

Temperature Measuring Apparatus for Flowing Fluids.

We, HONEYWELL INC., formerly known as MINNEAPOLIS-HONEYWELL REGULATOR COMPANY, a Corporation organized and existing under the laws of the State of Delaware, United States of America, of 2747 Fourth Avenue South, Minneapolis 8, Minnesota, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to temperature-measuring apparatus for flowing fluids.

An object of the invention is to provide a hygienic device which will accurately measure the temperature of a fluid mass within a flow pipe.

More specifically it is advantageous to employ this temperature-measuring device to measure accurately the temperature of a flowing fluid such as milk. Milk and like fluids are required by public health laws and trade associations to pass accurate temperature test measurement during the time they are undergoing pasteurization or other treatment in a milk processing plant.

Prior temperature-measuring devices which have employed a thermally-sensitive liquid, thermistor or a thermocouple within a metal probe to sense the temperature of fluids of this type have not been satisfactory because of the following reasons: Firstly, heat given out by the fluid at positions away from the point where a temperature measurement is being taken may vitiate the measurement. Secondly, heat due to changes in ambient temperature may be transmitted through the pipe wall and the metal probe and prevent the true temperature of the liquid at a desired point in the flow line from being measured.

The present invention seeks to provide a temperature-measuring device that eliminates these causes of inaccurate temperature-sensing and is particularly hygienic.

According to the present invention, a device to measure the temperature of a fluid flowing through a flow-tube comprises a thin-walled tube-length inserted into a gap in the flow tube and contiguously united at its ends to the tube ends bounding the gap so as to form a continuous straight-through flow passage of substantially unchanging cross-section for said fluid, a jacket or case secured externally on to said tube-length to form an enclosed dead space against the outer wall of the tube-length, and an electrical temperature-ensing element positioned within said jacket or case substantially centrally between the ends thereof and contiguous with the outer wall surface of said tube-length, all the walls of the jacket being spaced from the temperature-sensing element and the dead space enclosed within the jacket or case serving to isolate the temperature-sensing element from undesirable ambient temperature effects.

If the temperature-sensing element is a thermocouple the hot junction is placed on the tube wall mid-way between the ends of the jacket or case. Alternatively, the temperature-sensing element may be an electrical resistance coil, in which case the coil is disposed centrally between the ends of the case.

The temperature-sensing device is extremely hygienic because no portion of the temperature-sensing element contacts the fluid or protrudes into the flow path of the fluid but the fluid flows in a clean straight-through passage. Hence the temperature - sensing element does not have to be steam cleaned after use to remove any fluid that may have adhered thereto or bacteria which may have grown thereon, as is required when probe

type temperature-sensing elements are used.

There will now be described practical embodiments of the invention, reference being had to the accompanying drawings in which:—

Figure 1 is a longitudinal section through one embodiment;

Figure 2 is a detail view, partly in section, of a second embodiment; and

Figure 3 is a section on the line 3—3 of Figure 2.

In Figure 1 of the drawings, two open-ended portions 10, 12 of a thin-walled flow tube 18 abut against the ends 14, 16 of a centre portion 26 of the flow tube, suitable brazed or welded joints 20, 22 being provided. Fluid, which may be either gaseous or liquid, flows through the tube in the direction of the arrow 24.

Tightly coiled about the outer wall of the tubular portion 26 are ten turns of insulated thermocouple wire 27 comprised of two dissimilar thermocouple leads 28, 30 which are covered by insulating material 32 such as "Teflon" (Registered Trade Mark). The bare ends of these thermocouple leads 28, 30 are brazed or silver soldered at 34 and 35 to the outer surface of the tubular portion 26 to form a hot junction.

The opposite ends of the thermocouple leads at 36 pass through a passageway 38 formed in the wall of a jacket 40 which surrounds and is spaced from the tubular portion 26. A sleeve 42 inserted in this passageway 38 is welded to the exterior of the wall of the jacket 40 at 44. The space between the sleeve 42 and the covered thermocouple leads 36 is sealed off by any suitable temperature-resistant sealing material 46 such as an epoxy resin.

A casing 48, forming a thermocouple connection box, is screw-threadedly connected at 50 to the sleeve 42. A lead protected by a steel conduit 52 is connected between this connection box 48 and a portentiometric indicating meter 54 incorporating a cold junction.

The indicating meter is provided with a pen 56 which moves across a chart 57 in one direction or the other depending on whether the temperature being sensed at the hot thermocouple junction 34, 35 is being increased or decreased. The meter 54 also has a rotary pointer 58 to indicate whether the aforementioned temperature sensed by the thermocouple at its hot junction is increasing or decreasing.

The jacket about the tube 26 is closed by end walls 60, 62. The inner edge of each end wall 60, 62 is welded to the thin wall tube 26 as indicated at 64, 66. The outer peripheral edges of these end walls are likewise welded to the ends of the tube part of the jacket 40 as indicated at 68, 70.

It is preferred that the flow tube 26 be made of a good heat conduction metal such as copper, aluminium, or an alloy of either. However, other slightly less heat-conductive materials such as stainless steel, or stainless steel with either a copper or aluminium coating or copper strips bonded to its exterior surface in the area in which the hot thermocouple junction temperature measurement is to be made, may also be satisfactorily used.

By placing jacket 40, 60, 62 about tube 26 the hot junction formed between the ends of the thermocouple leads 28, 30 attached at 34 and 35 to the tube is thus isolated from any undesired effects that changes in ambient temperature might otherwise have on the true temperature of fluid being sensed at this hot thermocouple junction. The space formed by the jacket 40, 60, 62 about the flow tube 26 is a closed air space and provides a comparatively large volume into which the heat from the hot junction of the thermocouple can readily dissipate. This comparatively large jacketed dead air space prevents any excess local heat from building up around the thermocouple junction which otherwise might cause it to sense an erroneous temperature of the fluid passing through the tube 26.

Another advantage of this arrangement is that such an enclosed dead space formed by the jacket 40, 60, 62 allows any heat which is being conducted along the wall toward the hot thermocouple junction 34, 35, from portions of the tube which are located to the left and right of that junction, to be dissipated into this space before it reaches the hot junction. In this capacity the closed air space again advantageously serves as a means of assuring that only the true temperature of the fluid within the flow tube will be sensed by the hot junction of the thermocouple. It will be noted that the thermocouple junction 34, 35 is disposed substantially midway between the ends 60, 62 of the jacket.

Experiment has shown that ten tightly wrapped coils of thermocouple wire 27 are a suitable number to prevent any stray heat changes which may be picked up by the thermocouple wire from affecting the e.m.f. or current flow in this thermocouple wire that is caused by the temperature sensed at the hot junction 34, 35.

Figures 2 and 3 show how a resistance coil element 72 of a resistance thermometer 74 which is comprised of a fine wire, such as platinum, can be connected to the outer surface of the tube 26. The leads 76, 78 of this resistance thermometer 74 protrude from the coiled sensing element 72 through a case 80 and may be connected to a resistance thermometer bridge circuit (not shown) to enable the temperature of the fluid flowing through the tube 26 to be measured. The

case 80 can be formed of suitable insulating material, such as fibreglass, and completely surrounds the coil element 72, being bonded around its entire peripheral edge to the tube 26 by means of a heat resisting element. It will be observed that the coil 72 is disposed substantially centrally in the tube area enclosed by the case 80.

Both arrangements provide a hygienic flow tube having an associated temperature-sensing element which flow tube can be readily installed as any part of a process flow line without interfering with the flow of fluid passing therethrough or requiring the temperature sensing element which is measuring the temperature of the fluid in this flow line to be cleaned off by steam after use in order to rid it of any bacteria or other foreign matter that was present in the fluid. In either arrangement the space within the jacket or case enclosing the temperature sensor may be evacuated if desired.

WHAT WE CLAIM IS:—

1. A device to measure the temperature of a fluid flowing through a flow tube, comprising, a thin-walled tube-length inserted into a gap in the flow tube and contiguously united at its ends to the tube ends bounding the gap so as to form a continuous straight-through flow passage of substantially unchanging cross-section for said fluid, a jacket or case secured externally on to said tube-length to form an enclosed dead space against the outer wall of the tube-length, and an electrical temperature-sensing element positioned within said jacket or case substantially centrally between the ends thereof and contiguous with the outer wall surface of said tube-length, all the walls of the jacket being spaced from the temperature-sensing element and the dead space enclosed within the jacket or case serving to isolate the temperature-sensing element from undesirable ambient temperature effects.

2. A device as claimed in Claim 1, wherein the space within the jacket or case is a dead air space.

3. A device as claimed in Claim 1, wherein the space within the jacket or case is evacuated.

4. A device as claimed in Claim 1 or Claim 2 or Claim 3 wherein the temperature-sensing element has electrical connection leads extending out from the jacket or case through a substantially air-tight seal.

5. A device as claimed in any one of the preceding claims, wherein the jacket or case, and the dead space it encloses, is elongated in the cirection of length of the tube.

6. A device as claimed in any one of the preceding claims, wherein the temperature-sensing element is a thermocouple junction affixed to the external wall of the tube-length.

7. A device as claimed in any one of the preceding claims wherein the temperature-sensing element is a temperature-sensitive resistance coil affixed to the external wall of the tube-length.

8. A device as claimed in Claim 6 wherein the jacket or case extends continuously around the tube-length and the thermocouple junction is at the ends of two dissimilar thermocouple wires that form a coil closely wound around the tube-length within the jacket, these wires being insulated from the tube except at their ends where they form the junction.

9. A device as claimed in Claim 8, wherein the coil has about ten turns.

10. A device as claimed in Claim 8 or Claim 9, wherein at its end opposite to that of the junction the coil is connected into circuit with a potentiometric meter unit.

11. A device to measure the temperature of a fluid flowing through a flow tube, substantially as described with reference to, and as illustrated in, Figure 1 or Figures 2 and 3 of the accompanying drawings.

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FIG. 1

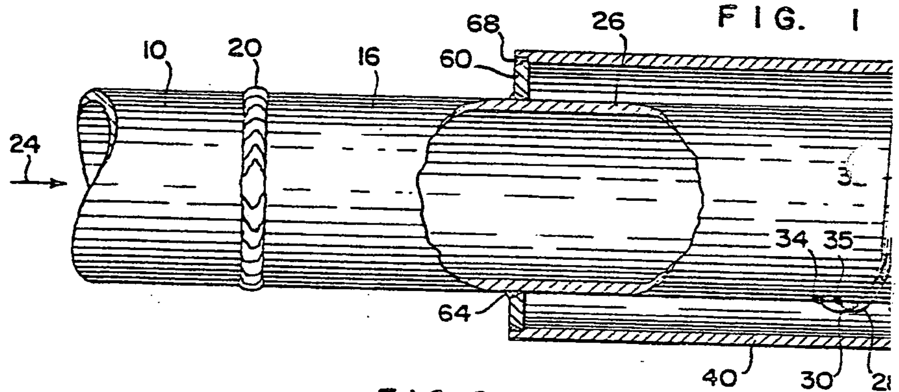


FIG. 2

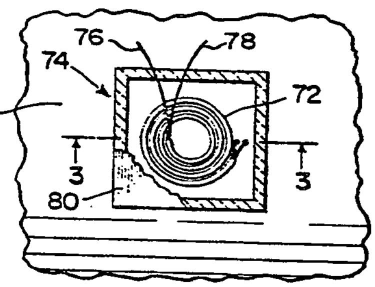
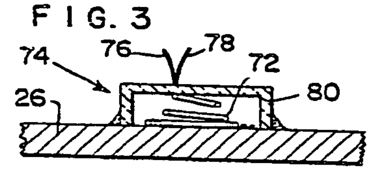


FIG. 3



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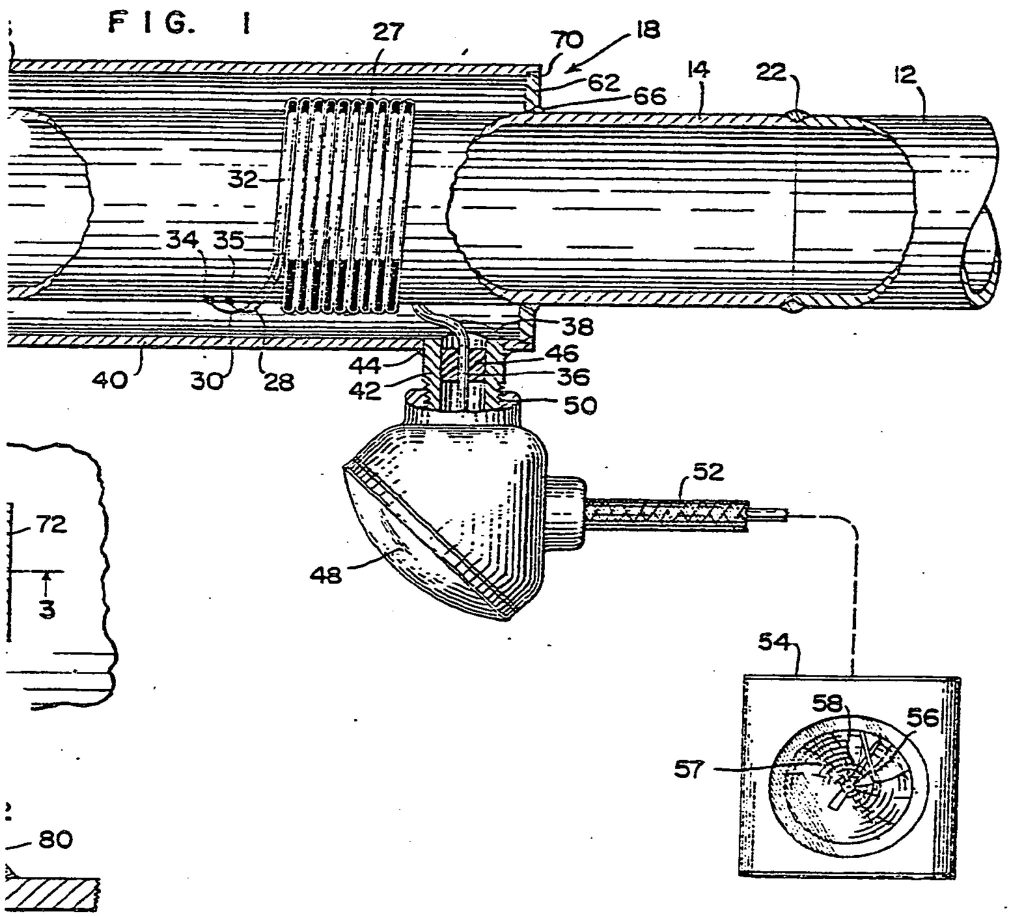

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